1. Name of the Scholar:

(In English): **Sakshi Pathak**

(In Hindi): **साक्षी पाठक**

2. Title of the Research Work :

(In English): **Harnessing Potential of Drumstick Leaves (*Moringa oleifera*) for Value Addition and Therapeutic Prospects**

(In Hindi): **सहजन की पत्तियों का मूल्य संवर्धन एवं उपचारात्मक संभावना हेतु शक्यता अन्वेषण**

3. Location

a. Department : Department of Food Science and Nutrition
Maharshi Dayanand Saraswati University ,Ajmer

b. Geographical area: Ajmer city, Rajasthan

4. Introduction and Importance of Proposed Research Work

The use of plants in traditional medical practice has a long drawn history, and remains the mainstay of primary health care in most of the world. From a historical perspective, it is evident that the fascination for plants is as old as mankind itself. The plant kingdom represent a rich store house of organic compounds, many of which have been used for medicinal purposes and could serve as lead for the development of novel agents having good efficacy in various pathological disorders in the coming years. Plants are the richest source of drugs for traditional medicine, modern medicines, nutraceuticals food supplements, folk medicine, pharmaceutical intermediates and chemical entities for synthetic drugs (Hammer *et.al.,* 1999). The use of plant

product as medicines could be traced as far back as the beginning of human civilization. The earliest mentioned medicinal used plant in Hindu culture is found in "Rigveda", which is said to have been written between 4500-1600 B.C. and is supposed to be the oldest repository human knowledge. The active principle isolated, have provided leads in the development of several life saving drugs, which are in use today (Rastogi and Mehrotra, 2002).

Traditional medicines are used by about 60% of the world population in both developing and developed countries. An estimated 60-80per cent Africa's and Latin America's population depends solely on herbal remedies for its primary health care needs. In diversity, plants are thought to be between 250,000 to 400,000 species spread across all continents from the Antarctic to the Arctic. They thrive in all environments from the flooded planes to the deserts, and from those who live on the seas and oceans to others that thrive on fresh water and ponds (Adesuyi *et. al.,* 2012).

For classification and easy identification, plants were divided into different taxonomical groups known as kingdoms; these were further streamlined into phylum, class, order, family, genus and species. Within the family of the Moringaceae is found a miracle plant called *Moringa oleifera*. *M. oleifera* is the best known of the thirteen species in the genus Moringa of the family Moringaceae. *Moringa oleifera*, native of the western and sub-Himalayan tracts, India, Pakistan, Asia Minor, Africa and Arabia (Mughal *et.al.,* 1999) is now distributed in the Philippines, Cambodia, Central America, North and South America and the Caribbean Islands (Morton, 1991). In some parts of the world *Moringa oleifera* is referred to as the 'drumstick tree' or the 'horse radish tree', whereas in others it is known as the kelor tree (Anwar and Bhanger, 2003). While in the Nile valley, the name of the tree is 'Shagara al Rauwaq', which means 'tree for purifying'. In India, *M. Oleifera* is locally known as 'Saijihan and Sajna' (Fahey, 2005). *Moringa oleifera* is widely adapted to the tropics and sub tropics. Optimum leaf and pod production require high average daily temperature of 25-30^{o} C(77-86^{o} F) , well distributed annual rainfall of 1000-2000 mm (40-80 in.), high solar radiation and well- drained soils (Odee, 1998). Growth slows significantly under temperatures below 20^{o} C (68^{o} F). Ideal elevation is less than 600 m (1,970 ft). *Moringa oleifera* is relatively tolerant of drought and poor soils and response well to irrigation and fertilization. It is considered as one of the World's most useful trees, as

almost every part of the *Moringa oleifera* tree can be used for food, medication and industrial purposes (Khalafalla *et. al.,* 2010). People use its leaves, flowers and fresh pods as vegetables, while others use it as livestock feed (Anjorin *et. al.,* 2010). The most utilized component of *Moringa oleifera* is its leaves, which can be dried and ground up into a nutrient-dense powder. The leaves of this tree have the potential to improve nutrition, boost food security and foster rural development. Most people in India, however, are not aware of the potential benefits of *Moringa oleifera* which are classified under following category –

Nutritive value of *Moringa oleifera* leaves- *Moringa oleifera* leaves is exceptionally nutritious and a naturally organic health supplement that used in many therapeutic ways (DanMalam *et. al.*, 2001). These leaves are very rich source of nutrients as fresh leaves contains 75.9 per cent moisture, 92 Kcal energy, 6.7 gm protein, 12.5 gm carbohydrate, 1.7 gm fat and 0.9 gm fiber per 100 gm (Nutritive Value of Indian Food, 2004). On the other hand, nutrient composition of shed dried leaves contains 6 per cent moisture, 271.83 Kcal energy, 23.66 gm protein, 28.476 gm carbohydrate, 7.03 gm fat and 12.1 gm fibre per 100 gm (Joshi et. al. 2010).

Moringa oleifera leaf contains 0.85 gm iron, 440 mg calcium, 70 mg phosphorus per 100 gm of fresh leaves (Nutritive Value of Indian Food, 2004) and shed dried leaves have 24 mg iron, 3405 mg calcium and 218 mg phosphorus per 100 gm of dried leaves. (Joshi *et. al*., 2010) which itself indicates its importance as a source of minerals.

Its Vitamin composition value constitutes 6780 µg ß-carotene, 220 mg vitamin C per 100 gm of fresh leaves and 39600 µg ß-carotene, 140 mg vitamin C per 100 gm of shed dried leaves.

Moringa oleifera leaves are rich in antioxidant and bioactive compounds, such as flavonoids, phenolic acids, glucosinolates and isothiocanates, tannins and saponins (Popoola *et. al.,* 2013). These antioxidants have health promoting potentials in maintaining the balance diet and preventing free radical damage that can initiate many illnesses.

The therapeutic use of *Moringa oleifera* leaves in the Indian sub continent dates back to Antiquity.Traditionally leaves were applied as poultice to sores, rubbed on temples for headaches and are said to have purgative properties (Anwar *et. al.,* 2007). The foliage is eaten as greens, in salads, in vegetable curries, as pickles and for seasoning. The leaves were pounded up and used for scrubbing utensils and for cleaning walls and also to feed live stock.

Recently, a high degree of renewed interest was placed on the nutritional properties of *Moringa oleifera* in most countries where it was not native (Reyes *et. al.,* 2006). This could be due to the claims that it has nutritional, therapeutic and prophylactic properties.

Nutritional Benefit - *Moringa oleifera* trees are known to overcome protein deficiency in developing countries as the leaves and other parts of the tree contain high amount of crude proteins and amino acids compared with soy bean. *M. Oleifera* leaves contain all of the essential amino acids, which are the building blocks of proteins. It is very rare for a vegetable to contain all of these amino acids and *Moringa oleifera* contains these amino acids in a good proportion, so that they are very useful to our bodies. *Moringa oleifera* leaves could be a great boon to people who do not get protein from meat. *Moringa oleifera* even contains two amino acids i.e arginine and histidine which are especially important for infants as they are unable to make enough protein for their growth requirements (Gopalan *et. al.,* 1971, Manzoor *et.al.,* 2007).

Moringa oleifera is successfully used for combating malnourishment in children and to boost their immune system as *Moringa oleifera* leaves contain more vitamin A than carrots, more vitamin C than oranges, more calcium than milk, more potassium than bananas, more iron than spinach, and that the protein quality of *M. Oleifera* leaves rivals that of milk and egg" (Fahey 2005). As a whole, *Moringa oleifera* is a natural, whole-food source for vitamins, minerals, protein, antioxidants, and other important compounds that your body relies on to stay healthy.

Moringa oleifera is an herbal galactagogue that has been widely used in the Philippines and some parts of the world. *Moringa oleifera* is often called "Mother's best friend" as pregnant women and lactating mothers use the powdered leaves to enhance their child or children's nourishment (Lockett *et. al.*, 2000). One 100 g portion of leaves could provide a woman with over one third of her daily need of calcium and give her important quantities of iron, protein, copper, sulfur and B-vitamins. *M. Oleifera* is especially useful for children and women who are anemic due to their menstrual cycles (Prakash 1988). Due to its nutritional benefits three nongovernmental organizations in particular–Trees for Life, Church World Service and

Educational Concerns for Hunger Organization–have advocated *Moringa oleifera* as "**natural nutrition for the tropics."**

Therapeutic uses-Antioxidants play an important role in inhibiting and scavenging free radicals, thus providing protection to human against infections and degenerative diseases. The extracts of both mature and tender leaves of *Moringa oleifera* tree have potent antioxidant activity against free radicals, prevent oxidative damage to major bio molecules and afford significant protection against oxidative damage (Sreelatha & Padma, 2009).

A variety of detoxication and antioxidant enzymes are present in *Moringa oleifera* or isolated from *Moringa oleifera* have shown, antiulcer, effect on immune response, spasmolytic activities, hypercholesterolemia effects, antibacterial activity (Talreja, 2010). A number of phytochemicals are identified in *Moringa oleifera* leaves or isolated from it contains Glycosides like isothiocyanates, malonates and flavonoids (Bennett *et. al.*, 2003).These phytochemicals can modulate lipid peroxidation involved in atherogenesis, carcinogenesis and thrombosis and other known properties of free radical scavenging or inhibition of hydrolytic and oxidative enzymes (phospholipidase A2, cyclooxygenase, lipooxygenase), shows strong antioxidant and anti-inflammatory activity (Siddhuraju *et. al.*, 2003).

Cardiovascular diseases (CVD) such as coronary artery disease (CAD) & stroke are the largest causes of death in developing countries & are one of the main contributors to disease burden in a population. It is expected that by 2020 in developing countries, non-communicable diseases (NCDs) will account for 69 per cent of all deaths, with cardiovascular diseases in the lead (Boutayb *et. al*. 2005). Hypertension and chronic Dyslipidemia are major cause of atherosclerosis. Dyslipidemia is a disorder characterized by alterations in the levels and composition of plasma lipids. According to Adult Treatment Panel III (2001), plasma levels ≥200 mg/dL for TC, ≥130 mg/dL for LDL-C, <40 mg/dL for HDL-C, and ≥ 150 mg/dL for TG are dyslipidemic.

Dyslipidemia may result from in born defects of lipoprotein production or metabolism, but in most cases, it is secondary to an unhealthy lifestyle (e.g., excessive cigarette smoking or alcohol consumption), other health disorders (e.g., obesity, diabetes, infection, obstructive liver disease),

or medication (e.g., β blockers, steroids). Apart from this oxidative stress is widely accepted as a major contributing factor in pathogenesis of CVD. The high anti-oxidant capacity (Dhalla et. al. 2000), anti inflamatory property, high fibre 12 per cent (w/w) content and bioactive phytochemicals (Lin *et. al*., 2010) present in *M.oleifera* leaves is the recurring explanation of its therapeutic potential in treatment of Dyslipidemia.

The leaves of *Moringa oleifera* can be consumed fresh, boiled, or kept as a dried powder for countless months supposedly without any major damage of its nutritional value. Even the micro-nutrient content is even more in dried leaves, ten times the vitamin A of carrots, 17 times the calcium of milk, 15 times the potassium of bananas, 25 times the iron of spinach and nine times the protein of yogurt however, Vitamin C drops to half that of oranges (Manzoor 2007 and Tree for Life 2005).

The low moisture content of the leaf powder is an attribute to a very high shelf life. Hence, long storage of the leaf powder would not lead to spoilage due to microbial attack and this supports the practice of storage in dry form by users. Also, moisture content is among the most vital and mostly used measurement in the processing, preservation and storage of food.

Therefore it is necessary to increase the utilization of *Moringa oleifera* leaves consumption by the different communities. It should be consumed either fresh or dry. Dried leaves can be stored for a long time and can be used regularly. Another way of consuming dried *Moringa oleifera* leaves is to incorporate it in various products e.g. bread, biscuits, ice cream, noodles to increase its acceptability in the society.

Ajmer city is the fifth largest city in the Indian state Rajasthan, surrounded by the Aravalli Mountains. It is situated almost in the center of Rajasthan. It has a hot semi arid climate with over 55 cm. (25.4 inch.) of rain every year. Temperature remains relatively high throughout the year. Since the climate of Ajmer city is favorable for the growth of *Moringa oleifera* trees therefore one can easily found these trees in this area. The people residing in the area consumes drumsticks and flowers in their diet which are available to them seasonally on the other contrary *Moringa oleifera* leaves which can be stored easily in dried form for whole year are not used

commonly in diet. This research is an attempt to analyse the proximate principals, micro nutrients and phytochemicals present in dried *Moringa oleifera* leaves and also to create an awareness about the nutritional benefits of these leaves through product development in such a way which is acceptable in the society. The research work on the topic has been opted to investigate the possible utilization of *Moringa oleifera* leaves powder in daily life style and to assess its usefulness as herbal medicine in combating Dyslipidemia, a major cause of heart diseases. Dyslipidemia is a sedentary lifestyle disease and increasing rapidly in metro and semi metro Indian cities like Ajmer with an alarming rate.

Therefore the study entitled "Harnessing Potential of Drumstick Leaves (*Moringa oleifera*) for Value Addition and Therapeutic Prospects" is proposed to be undertaken with the following objectives-

Objectives-

1. **To analyze proximate principles, micro nutrients and phytochemicals present in dried *Moringa oleifera* leaves powder.**
2. **Evaluation of acceptability of value added products developed from dried *Moringa oleifera* leaves powder.**
3. **To study shelf life of primary processed and value added products.**
4. **To assess the therapeutic potential of *Moringa oleifera* leaves with special reference to Dyslipidemic subject.**

5. Review of Literature

The planning and execution of any research study should be preceded through review of literature in the related field. A review helps to familiarize the researcher with the work that has been done in the areas of one's interest and helps to provide useful information in planning the study. It is desirable and necessary to review previous study done on the related topic, for any study to be meaningful and significant.

A review study of *Moringa oleifera* was conducted by Khawaja *et. al.,* (2010) signifies its nutritional value as it is one of the richest sources of Vitamins A, B, C, D, E and K. It has a

perfect composition of minerals in it, which include Calcium, Copper, Iron, Potassium, Magnesium, Manganese and Zinc. Moreover, it has more than 40 natural anti-oxidants. Due to its medicinal and nutritional values it is used in more than 80 countries to improve mineral and vitamin deficiencies, for healthier cardiovascular system, balancing blood-glucose levels, to reduce malignancy by neutralizing free radicals, provide excellent support of the body's anti-inflammatory mechanisms, enrich anemic blood and support immune system. It also has positive impact in improving eyesight, mental alertness and bone strength. Study moreover signifies its potential benefit in combating malnutrition, general weakness, lactating mothers, menopause, depression and osteoporosis. Overall, this study glorifies the richness of *Moringa oleifera* due to which has been used since 150B.C. by ancient kings and queens in their diet.

A study was done to assess the nutritional value of *Moringa oleifera* leaves using Proximate and Ven Soest methods. This analysis revealed that the dried leaves had 9.5 per cent moisture, 30.3 per cent crude protein levels and 19 amino acids, and 6.5 per cent fat with 17 fatty acids in which α-Linolenic acid (44.57%) having the highest value followed by heneicosanoic (14.41%), g-linolenic (0.20%) palmiteic (0.17%) and capric acid (0.07%). The dried leaves had the following mineral contents: calcium (3.65%), phoshorus (0.3%), magnesium (0.5%), potassium (1.5%), sodium (0.164%), sulphur (0.63%), zinc (13.03 mg/kg), copper (8.25%), manganese (86.8 mg/kg), iron (490 mg/kg) and selenium (363 mg/kg). Vitamin E had the highest concentration of 77 mg/100 g than beta-carotene, which had 18.5 mg/100 g in the dried leaves. The fiber content was neutral detergent fibre (NDF) (11.4%), acid detergent fibre (ADF) (8.49%), acid detergent lignin (ADL) (1.8%) and (acid detergent cellulose (ADC) (4.01%). The condensed tannins had a value of 3.2 per cent, while total polyphenols were 2.02 per cent. The values of amino acids, fatty acids,minerals and vitamin profiles reflect a desirable nutritional balance.(Busnai 2011)

Dry leaf powder of *M. Oleifera* is an excellent source of nutrients and phytochemicals and these properties of *Moringa oleifera* leaves are used as nutraceuticals, dietary supplements and functional food. Chinwe *et. al.,* (2015) conducted a study to investigate these nutritional and phytochemical properties of *Moringa oleifera* leaves. The nutritional analysis was done using standard official methods and gas chromatography revealed the following nutrients,

proteins (24.31%), carbohydrate (55.97%), ashes (11.50%), crude fiber (10.28%), total fat (9.22%), moisture (6.12 %), caloric value (404.10 Kcal/100g) and saturated fatty acids (3.77 %), unsaturated fatty acids (5.45 %), MUFA (0.87%), PUFA (4.58 %) and Trans fatty acid (0.00%) for fatty acid profile. Using acid hydrolysis and ion-exchange chromatography, the amino acid analysis report showed the presence of essential and semi essential amino acids in varying amounts. Using standard phytochemical screening procedures the phytochemicals identified were tannins, saponins, alkaloids, flavonoids, cardiac glycosides and reducing sugars.

An experimental research was carried out by Sreelatha *et. al.,* (2009) to understand the mechanism of pharmacological actions, antioxidant properties of the *Moringa oleifera* leaf extracts which were tested in two stages of maturity using standard in vitro models. In study a strong scavenging effect on 2, 2-diphenyl-2-picryl hydrazyl (DPPH) free radical, superoxide, nitric oxide radical and inhibition of lipid per oxidation was exhibited due to the successive aqueous extract of *Moringa oleifera*. On the basis of data collected and studied it is suggested that the extracts of *Moringa oleifera M. Oleifera* both mature and tender leaves have potent antioxidant activity against free radicals, prevent oxidative damage to major biomolecules and afford significant protection against oxidative damage.

Dachana *et.al.,* (2010) studied the characteristics i.e rheological, microstructural, nutritional and other quality characteristics of cookies after replacing wheat flour with 5, 10 and 15 per cent dried *M. Oleifera* leaves powder (DML) . The results shows increased farino graph water absorption and decreased dough stability, amylograph pasting temperature and peak viscosity after incorporation of increasing amount of DML from 0 to 15per cent. The results showed the possibility of utilizing DML to improve the nutritional characteristics of cookies as use of DML increased dough hardness and decreased cohesiveness and spread ratio of cookies. On the basis of Sensory evaluation it was suggested in the study that cookies incorporated with 10 per cent DML powder were more acceptable. Also, with increasing amount of DML from 0 to 15 per cent the nutrient content i.e. protein, iron, calcium, ß-carotene and dietary fiber were increased

A study was conducted by Jalaja Kumari (2010) in which 55 non insulin dependent diabetics, in age group of 30-60 years were selected from the Hospital of Acharya Nagarjuna University and Diabetic Care hospital, Guntur and divided into two Experimental (n=46) and control group (n=9). The first experimental was administered *M. oleifera* leaves powder (8gm) and second experimental group was administrated Azadirachta indica seeds powder (6gm) per day respectively in three divided doses for 40 days. The control group of 9 subjects did not receive any treatment. A significant reduction in the mean blood lipid levels of the subjects who were administered the two herbal powders was observed i.e. from 261±20.0 mg/ dl to 224.0±22.6 mg/dl for first experimental group and in second experimental group it reduced form 204±21.4 mg/dl to 204±30.1mg/dl . Among the two herbs selected *M. oleifera* leaves powder was found to be more effective followed by Azadirachta indica seeds powder.

Bidwe *et. al.,* (2013) conducted a study to found out the effect of *M. Oleifera* leaves powder supplementation on Blood Pressure of 20 purposively selected hypertensive subjects. The subjects were divided into Control (n= 10) and Experimental group (n=10). Experimental group was supplemented with 20 gm *Moringa oleifera* leaves chutney (which contain 4 gm of *M. oleifera* leaves powder along with powder of Bengal gram dal and Black gram dal, Niger seed, jiggery, tamarind and chili powder) for a period of 60 days, whereas control group received no supplementation. The blood pressure was observed and recorded at 0, 30 and 60 days of the experimental period. At the end of intervention period supplementation of *M. oleifera* leaves powder chutney showed significant improvement in the blood pressure levels, systolic (131 mm Hg to 116 mm Hg) and diastolic (86 mm Hg to 78 mm Hg).

To assess the impact of anti oxidant present in dried *M.oleifera* leaves powder on the lipid profile of hyperlipidemic, a study was conducted by Nambiar *et.al.*, (2010) on 35 hyperlipidemic subjects (serum total cholesterol >180 mg/dl and/or serum triglycerides 140 mg/dl). These subjects were randomly divided in to Experimental group (n =17), who supplemented with 8 tablets, each of contained 575 mg of dried *M. oleifera* leaf powder (which was equivalent 4.6 gm dried Moringa leaf powder) for a period of 50 days ,and Control group (n=18), who were not given any supplementation. General information,

personal habits, medical history, 24-h dietary recall, anthropometric measurements like height, weight, waist, hip, BMI and waist to hip ratio was recorded at baseline and lipid profile was recorded at base line and after 50 days of intervention period. The Dried *M. oleifera* leaf tablet supplementation had an overall positive impact on the lipid profile, wherein significant reduction in the non-HDL values was observed.

6. Research Gap:

A research gap is defined as a topic or area for which missing or insufficient information limits the ability to reach a conclusion for a question. Research gap is a knowledge gap in an area that need to be investigated.

The major research gap which are identified during the review of literature are as follows-

i. No research work related to the analysis of *M. oleifera* leaves powder and value added product development has ever been conducted in the Ajmer city.
ii. And, there are very limited human trials of dried *M. oleifera* leaves powder to assess its therapeutic potentials in treatment of Dyslipidemia.

The present study has therefore been planned to find out the nutritional and nutraceutical value of *M. Oleifera* leaves powder and development of value added products and their shelf life evaluation and also to assess its therapeutic potentials in treatment of Dyslipidemia.

7. Hypothesis:

Hypothesis considered as the principal instrument in research its main function is to suggest new experiments and observations. In simple words, hypothesis is a mere assumption or some supposition to be proved or disproved. But for a researcher hypothesis is a formal question that he or she intends to resolve quiet often a research hypothesis is a predictive statement, capable of being tested by scientific methods, that relates an independent variable to some dependent variable.In this research work the hypothesis is as follow:-

"If dyslipidemic subjects treated with dried *M. oleifera* leaves powder then their lipid profile will improve because of the nutritional and therapeutic properties of *M. oleifera* leaves".

8. Material and Methodology

Methodology is the mode of collecting the data for the study undertaken. It deals with the methods and procedures used in execution of any study. One can explore the problem in a variety of ways, but the method and procedure used in the study should be such, that it provides a sound and a solid basis for accurate communication and reliable results.

The research will be carried out five phases-

- Phase I- Analysis of proximate principles, micro nutrients and phytochemicals present in dried *M. oleifera* Leaves powder.
- Phase II- Development of value added products using dried *M. oleifera* leaves powder.
- Phase III- Acceptability evaluation of value added products.
- Phase IV- To study the shelf life of primary processed and value added products.
- Phase V- Impact of dried *M. oleifera* leaves powder on Dyslipidemic subjects.

8.1 Phase I: Analysis of proximate principles, micro nutrients and phytochemicals present in dried *M. oleifera* Leaves powder.

8.1.1 Plant Collection and Preparation of *M. oleifera* leaves powder

The leaves of *M. oleifera* used for this study will be collected from the matured tree of Ajmer City, Rajasthan (26° 27' 0" N, 74° 38' 0" E). The mean annual rainfall of the city is approx. 557 mm and the mean annual temperature is 24.7° C. The leaves will be collected from Eastern, Western, Northern and Southern parts of Ajmer city during summer season in months of April - June. After collection, the leaves will be removed from the branches, sorted out to separate the bad ones from the good ones, washed properly with clean water and spread on clean mesh trays for drying. The leaves were shade dried for a period of 7 – 10 days for proper drying. Upon drying, the leaves will be pulverize under aseptic conditions using a grinder into fine powdery form, sieved and stored in dry airtight glass jar for nutritional and phytochemical analysis.

8.1.2: Nutritional Evaluation of *M. Oleifera* Leaves powder

Proximate analysis is a conventional system of analysis that gives the quantitative as well as qualitative ideas of nutrients present in a particular food sample. Likewise in this research, dried

powder of *M. oleifera* leaves will be assessed for its moisture content, crude protein, total carbohydrate, crude fibre calcium, iron, zinc, ß-carotene and Vitamin C using standard methods.
.

8.1.3: Phytochemical Analysis

To harness the nutraceutical potential of *M. oleifera* leaves their flavonoids, polyphenols, tannins, saponins, Alkaloids will be assessed using standard methods.

8.2 Phase II- Development of value added products using dried *M. oleifera* leaves powder

Keeping in mind the nutritional and therapeutic potentials of *M. oleifera* leaves various value added products of industrial use will be developed to supplement an individual which in turn will be beneficial to the society as a whole.

8.3 Phase III- Acceptability evaluation of value added products

Products develop will be organolepticaly evaluated for their color, appearance, texture, flavor, taste and overall acceptability using Nine Point hedonic rating scale.

8.4: Phase IV- Shelf life evaluation of primary processed and value added products of *M. oleifera* leaves powder

Shelf Life Evaluation: Shelf life of primary processed product Dried *M. oleifera* Leaves Powder (DMOLP) and value added products will be determined on a regular interval of one month for the period of three months. Determination will be based on organoleptic evaluation, Rancidity of fat and microbial analysis. For microbial analysis Aerobic mesophilic Plate count and for Fat rancidity Acid value and Peroxide value will be used.

8.5 Phase V- Impact of dried *M. oleifera* leaves powder on Dyslipidemic subjects

Coronary artery diseases are caused by multiple factors. Dyslipidemia is one among of those many factors. The present study is undertaken to compare the effects of supplementation of *M. oleifera* leaves powder in capsule form, on the blood lipid profiles of hypercholestrolemic patients.

8.5.1: Locale of Investigation

The study will be conducted on the subjects of age group of 40-60 years, and who are willing for clinical trial.

8.5.2: Size and Selection Sample

Already diagnosed Dyslipidemic patients and non-Dyslipidemic subjects will be included in the study using purposive sampling technique. The subjects will be divided in two groups Group A (Non Dyslipidemic subjects) and Group B (Dyslipidemic subjects) .

Exclusion criteria of the subjects for study are those who are taking any lipid lowering drug showing Abnormal ECG or coronary angiogram, Positive stress test and Diabetes.

8.5.3: Methodology

A self-designed Questionnaire will be formulated to elicit information regarding the age, education, life style, food habits & disease specific information- age of onset, family history, associated disease and symptoms of subjects.

For the assessment of nutritional profile of the subjects Anthropometry, Biochemical and Bio-physical method will be used.

8.5.4: Intervention with *M. oleifera* leaves powder capsule

Subjects of both groups will be given capsule of 1 gm dried *M. oleifera* leaves powder twice daily. The period of this intervention will be of one month. Anthropometric, Biochemical and Bio-physical assessment will be done at base line of intervention period and then on last day of intervention period.

8.6: Statistical Analysis

Once the data collected, it will be processed and analysed to obtain usable and useful information to reach the objective for which research has been planned. The collected data will be analysed with the help of appropriate statistical tools with which it can be said to indicate any conclusion.

9. References

1. Adesuyi, A.O., Elumm, I.K., Adaramola, F.B. and Nwokocha, A.G.M. (2012): "Nutritional and Phytochemical Screening of Garcinia kola". Advanced Journal of Food Science and Technology, 4 (1) pp9-14.
2. Adult Treatment Panel III. (2001) Executive summary of the third report of The National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults JAMA 285 pp 2486–2497.
3. Anjorin, T.S., Ikokoh, P. and Okolo, S. (2010). "Mineral composition of M.oleiferaleaves, pods and seeds from two regions in Abuja, Nigeria". Int. J. Agric Biol., 12 pp 431-434.
4. Anwar, F. and Bhanger, M.I. (2003). "Analytical characterization of M.oleiferaseed oil grown in temperate regions of Pakistan". J Agric Food Chem 51 pp 6558–6563.
5. Anwar, F., Latif, S., Ashraf, M. and Gilani, A.H. 2007. Moringa Oleifera: a food plant with multiple medicinal uses. Phytother Res 21pp 17–25
6. Bennett, R. N., Mellon, F. A., Foidl, N., Pratt, J. H., Dupoint, S. M., Perkins, L. and Kroon, P. A. (2003). "Profiling Glucosinolates and phenolics in vegetative and reproductive tissues of the multi-purpose trees M. oleifera L. (Horseradish Tree) and Moringa stenopetala L". J. Agri. Food Chem.51pp 3546-3553.
7. Bidwe, A. and Khan, T. N. (2013). Effect of Drumstick (Moringa Oliefera) Leaves Powder Chutney on Blood Pressure. International Journal of Food And Nutritional Sciences. 2 (3) pp 95-98.
8. Boutayb, A., and Bboutayed, S. (2005). "The burden of non communicable diseases in developing countries". International Journal of Equity Health.4(2) pp176-186
9. Busani, M., Patrick, J.M. and Arnold, H. (2011). "Nutritional characterization of Moringa (M.oleiferaLam.) leaves". African Journal of Biotechnology. 10(60) pp12925-12933.
10. Chinwe, C. I., Maria, J., and Sanchez, M. L.(2015). "Phytochemical and nutritional properties of dried leaf powder of M.oleiferaLam. from machala el oro province of Ecuador". Asian Journal of Plant Science and Research. 5(2) pp 8-16.
11. Dachana, K.B., Rajiv J., Indrani, D. and Prakash J. (2010). "Effect of Dried Moringa (M.oleiferaLam) Leaves on Rheological, Microstructural, Nutritional, Textural and Organoleptic Characteristics of Cookies". Journal of Food Quality. 33 pp 660–677.
12. DanMalam, H. U., Abubakar, Z. and Katsayal, U. A. (2001). "Pharmacognostic studies on theleaves of Moringaoleifera". Nigerian Journal of Natural Product and Medicine.5 pp 45-49.
13. Dhalla, N.S., Temsah, R.M., and Netticadan, T. (2000). "Role of oxidative stress in cardiovascular diseases". J. Hypertens. 18 pp 655–673.
14. Fahey, J.W. (2005). "Moringa Oleifera: A review of the Medical evidence for its nutritional, Therapeutic and prophylactic properties". Tree for Life Journal. 1:5 pp 5-15.
15. Gopalan, C, Rama BV, Balasubramanian SC. 1971.Nutritive value of Indian foods. National Institute of Nutrition Hyderabad, India.
16. Hammer, K.A., Carson, C.F. and Riley, T.V. (1999). "Antimicrobial activity of essential oils and other plant extracts". J. Appl. Microbiol. 86 pp 985-990

17. Jalja, Kumari,D. (2010). “Hypoglycaemic effect of M.oleiferaand Azadirachta indica in type 2 diabetes mellitus”. Bioscan: an international Quarterly journal of life sciences. 5 (2) pp 211-214.
18. Joshi, P. and Mehta, D. (2010). Effect of dehydration on Nutritive value of Drumstick leaves. Journal of Metabolomics and System Biology 1(1) pp 5-9
19. Khalafalla, M.M., Abdellatef ,E., Dafalla, H.M., Nassrallah, A.A., Aboul-Enein, K.M., Lightfoot, D.A., El-Deeb, F.E. and El-Shemy, H.A. (2010). “Active principle from M.oleiferaLam Leaves effective against two leukemias and a hepatocarcinoma”. Afr. J. Biotechnol. 9(49) pp 8467-8471.
20. Khawaja,T.M.,, Tahira, M. and Ikram U.H. (2010). “Moringa oleifera: a natural gift-A review”. Pharm. Sci. Res.2 (11) pp 775-781 .
21. Lin, X., Racette, S. B., Lefevre, M.,,Spearie, C. A., Most, M. and Ostlund, R. E. Jr.(2010). “The effects of phytosterols present in natural food matrices on cholesterol metabolism and LDL-cholesterol: a controlled feeding trial”. Eur. J. Clin. Nutr. 64 pp 1481–1487.
22. Lockett, C. T., Calvert, C. C. and Grivetti L. E. (2000). “Energy and micronutrient compositionof dietary and medicinal wild plants consumed during drought. Study of rural Fulani, northeastern Nigeria”. Int. J. Food Sci. Nutr. 51pp 195-208
23. Manzoor, M., Anwar, F., Iqbal, T. and Bhnager, M.L.(2007). Physico-chemical characterization of Moringa concanensis seeds and seed oil. J. Am. Oil Chem. Soc. 84 pp 413-419.
24. Morton, J.F. (1991). “The horseradish tree, Moringa pterigosperma (Moringaceae). A boon to arid lands”. Econ Bot .45 pp 318–333.
25. Mughal ,M.H., G,Ali., Srivastava P.S. and Iqbal M. (1999). “Improvement of drumstick (Moringa pterygosperma Gaertn.) – a unique source of food and medicine through tissue culture”. Hamdard Med. 42 pp 37–42.
26. Nambiar, S. V., Guin, p., Parnami, S. and Daniel, M. (2010). “Impact of Antioxidants From Drumstick Leaves on The Lipid Profile of Hyperlipidemics”. Journal of Herbal Medicine and Toxicology. 4 (1) pp 165-172.
27. Nutrititive Value of Indain Food .(2004). Gopalan ,C., Sastri, B.V.R. and Balasubramanian, S.C. revised by Rao, B.S.N., Deosthale, Y.G and Pant, K.C. national Institute of Nutrition. ICMR, Hyderabad. A.P. (India).pp 49, 60.
28. Odee, D. (1998). “Forest biotechnology research in drylands of Kenya. The development of Moringa species”. Dryland Biodiversity. 2 pp 7-12.
29. Popoola, J.O. and Obembe, O. (2013. Local knowledge, use pattern and geographical distribution of M.oleiferaLam. (Moringaceae) in Nigeria. J. Ethnopharmacol. 150 pp 682–691.
30. Prakash, A.O. (1998). Ovarian response to aqueous extract of M.oleiferaduring early pregnancy in rats. Fitoterapia. 59 pp 89-96.
31. Rastogi, R.P. and Mehrotra, B.N. (2002).” Glossary of Indian Medicinal Plants”. National Institute of science communication, New Delhi, India. Pp20-25.
32. Reyes, Sanchez, N., Sporndly, E. and Ledin, I. (2006). “Effects of feeding different levels of foliage from M.oleiferato creole dairy cows on intake, digestibility, milk production and composition”. Livest. Sci.101(1-3) pp 24-31

33. Siddhuraju, P. and Becker, K. (2003). "Antioxidant prosperities of various solvent extracts of total phenolic constituents from three different agro climatic origins of drumstick tree (M. Oleifera)". Agric. Food Chem. 51pp 2144-2155
34. Sreelatha and Padma, (2009). "Antioxidant Activity and Total Phenolic Content of M.oleiferaLeaves in Two Stages of Maturity".Plant Foods Human Nutr. 64 pp 303–311
35. Talreja, T., (2010). "Screening of crude extract of flavonoids of M.oleiferaagainst bacteria and fungal pathogen". J. Phytol. 2 pp 31–35
36. Trees for Life.2005. Moringa Book. http://www.treesforlife.org/project/moringa/book/default.asp.

Signature of Candidate with Date

Sakshi Pathak 3/9/16

Sakshi Pathak
Research Scholar
Department of Food Science and Nutrition

Outline of the Synopsis is Approved

Signature of Supervisor with Date and Seal

3/9/16

Prof. Bharti Jain
Research Supervisor
Department M.D.S. University,
Ajmer of Food Science and Nutrition

(Dr. BHARTI JAIN)
Professor
Department of Food Science and Nutrition
M.D.S. University
AJMER-305009

Dept. of Food Science and Nutrition
M.D.S. University, AJMER 9.16